

Testimony of Ralph W. Seelke, Ph.D., before the Education Committee of the Michigan House of Representatives.

I have been asked to testify on behalf of HB5251, and I am happy to do so. Please note that my views are my own, and not those of my employer. (include the actual language of the bill here)

I hold a doctorate in Microbiology from the University of Minnesota, where my thesis work was in microbial genetics. By training, and perhaps by nature, I am an experimentalist: I am most assured as to the truth of a matter, when it can be demonstrated experimentally. I am currently a Professor of Biology at the University of Wisconsin-Superior. UW-Superior is a small, public liberal arts university in northwestern Wisconsin, and my primary duties there involve teaching students about the wonders of Genetics, Cell Biology, and Microbiology. Since 2000, UW-Superior has also been the place where I have pursued my research passion, which is answering a very simple, but important question:

## What can evolution REALLY do???

I have been pursuing this research with the help of funding from the Merck Foundation and also with the help of a sabbatical at Stanford University. It is partly on the basis of my experience as an evolution researcher that I come before you today. While this bill specifically mentions both global warming and the theory of evolution, my comments will be directed towards my support for critical analysis of evolution. However, I would support critical analysis of global warming as well, simply on the basis that this approach will also produce a more informed citizenry.

Why do I think that having students critically analyze evolution is a good idea? First of all, in **any** area where there is considerable disagreement, a sound teaching strategy is to teach the controversy: allow the students to examine both the strengths and weaknesses of arguments for both sides, and in so doing make up their own minds about the subject. There is a term used when we only want student to learn one side of a story. It is called indoctrination, not education.

In the case of the theory of evolution, it is often taught as if there is no disagreement about the theory, or that any disagreement was due to ideology, not science. One text that I have used said, in effect that Darwin's theory was SO convincing that it left no room for reasonable scientific doubt. Thus, those who questioned Darwin were either unreasonable or unscientific. In fact, over 600 Ph.D. scientists have signed "A Scientific Dissent from Darwinism", expressing public skepticism about the adequacy of evolutionary theory to explain the astonishing diversity and complexity of life as we know it- in other words, to truly "deliver the goods".

Most of us skeptics of evolution grew up in an environment where critical analysis of the theory of evolution was simply not done. Evolution was considered sacred Truth, to be believed, not analyzed. Any questions were to be left to the experts- the evolutionary biologists who would have the answers. Not that even they (the experts) knew everything that could be known about evolution, but the basic mechanism- that new forms and organisms could be produced by the gradual work of mutation and selection- was never challenged as adequate. The logic and extrapolations inherent in the evidence for evolution were to be accepted. If we had doubts as to whether peppered moths really had anything to do with how moths came to be in the first place, we kept them to ourselves. To do otherwise was to run the risk of being branded a heretic.

Ideas matter, as do the books that present those ideas. For many of us the eye-opener was Michael Denton's *Evolution: A theory in crisis*, Phillip Johnson's *Darwin on Trial*, or Michael Behe's *Darwin's Black Box*. For me, Behe's book was both the eye-opener and the challenge.

Darwin, in *The Origin of Species* "If it could be demonstrated that any complex organ existed which could not possibly have been formed by numerous, successive, slight modifications, my theory would absolutely break down."

I came to recognize that inside the cell were a multitude of molecular machines that met Darwin's challenge. There were little molecular motors that moved other molecular machines from one part of the cell to another. There were exquisitely controlled collections of enzymes that made the products needed by the cell, but only when needed, producing chemical reactions that were the envy of many an organic chemist. There were pumps, and sensors, and drills, and batteries. These machines met Behe's definition of irreducible complexity- they consisted of interlocking parts that needed each other to work such that, if any one part was missing, the entire machine ceased to function. Just as your car can be immobilized by the removal of a single part (think of the Nuns in "*Sound of Music*"), so each of these machines are rendered nonfunctional by the removal of single parts. It was not just that evolution lacked a plausible explanation for these machines; it was that evolution *in principle* lacked such an explanation- they could not be produced by small, gradual steps. What is required is multiple steps, all happening at the same time. Since Behe's work, an attempt at an explanation has been proposed- the theory of co-option; however, they were essentially speculations greatly lacking in evidence. In addition, true believers (i.e. Darwinists) seemed to be in no hurry to address these problems experimentally. After all, why explore a questions such as "What Can Evolution Really Do?" when you already have the answer? It was this lack of experimental evidence that led me to my current research, in which I ask trillions of bacteria, over thousands of generations, to do a very specific evolutionary task. So far my answer to "What can evolution really do?" is: Not Much.

It is this sort of experience that leads me to support HB 5251. During my formal education, I was shielded from the inconvenient facts about evolution. When a student gets a more complete picture of the evidence, there is often a sense of disillusionment about his/her education, and a sense of betrayal that can set in. I remember the shock that one student had in my genetics course, when she was told that the peppered moths pictured in her book were all dead moths, pinned or glued to the tree trunk, because no one had ever found them that way in nature. It was as if I had told a six year old that there was no Santa! Students can then ask, "if they hid facts about evolution, what else were they hiding?"

Contrast the benefits that critical analysis of evolutionary theory will have, as compared to our current method that ignores controversy and borders on indoctrination. Our better students already KNOW there is a controversy- most surveys indicate that upwards of 50% of Americans are skeptical of the theory of evolution as it is typically taught. Also ~ 70% favor students being taught both the strengths & weaknesses of evolution. When students are taught in typical manner ("there is no controversy"), Some will "buy the party line" without giving it much thought; others will cynically endure those parts of the course, giving the teacher what they want to hear. By encouraging critical analysis, you will have more INFORMED students and more ENGAGED students. The opinions that they reach will be the result of thought and discussion. They will be examining both sides of an important issue, and having to decide for themselves - can there be any better scenario for good learning? What better topic to have students think, read, debate, and form an opinion on? Who knows- students might become used to the idea that there are two sides to every serious issue, and might even develop the HABIT of thinking and reading about important issues!! Additionally, some of those students will go on to become scientists. Introducing students to the controversy may result in some of them actually doing the work that resolves some of these disagreements.

I have examined the current proposed standards for teaching evolution. I believe that they are good standards, but would be much improved by adding information that shows that this is a theory that is not without grounds for being questioned. I would like to give three examples where critical analysis would improve students' education in evolution. These additions would result in students learning MORE about evolution, not less!

#### **Origin of life- a gap in our students' education!**

To begin with, nothing is said in the standards about the origin of life. Students should know that life arose on this planet as soon as the earth was cool enough to support liquid water; there is very good evidence that bacteria were on this planet at 3.8 billion years ago. They should also be taught that we have a pretty clear idea now as to how many proteins are needed to produce a primitive cell: around 350-400, which would be

**Extra arguments.**

Finally, one could charge that teaching students the evidence both for and against evolution might lead students to not only view evolutionary theory as inadequate, but actually go on to favor Intelligent Design. What if the school actually had books that discussed ID in a favorable light, and allowed students to read those books? Might this be a violation of the First Amendment?

I would counter this charge with the current scenario: I am constantly meeting people whose journey into atheism began in earnest when they were taught evolution. In fact, atheism is almost always preceded or accompanied by Darwinism. Most of this happens in college, although sometimes in high school. However, no one considers this a violation of the first amendment. If we avoided teaching subjects because they touch upon religious questions, we would gut our schools of much of their curriculum.

What if students, while being indoctrinated in evolution, become atheists? While one can certainly believe in God and also in evolution (as the proponents of evolution frequently assert), it is also true that atheism is invariably preceded by Darwinism (Richard Dawkins, in fact stated that Darwinism allowed him to be an intellectually fulfilled atheist). Is this situation unconstitutional? It would be, if our first situation was declared unconstitutional.

**An example of where skepticism and further knowledge might have helped.**

Some may ask whether any of this matters. Let me give one concrete example of where an understanding of evolution- both its capabilities and its limitations- would have made a difference.

As you all know, antibiotic resistance is a serious medical problem. Our chances of dying from an infection are much greater today than they were, say, 50 years ago.

One of the problems with our introduction of antibiotics is that we did not plan for the resistance that emerged- a common evolutionary scenario. Knowing what we know now, about both the capabilities and limitations of evolution of antibiotic resistance, our strategy of employing antibiotics would have been drastically different. Instead of introducing antibiotics one at a time, and allowing microbes to evolve resistance, a much better strategy would have been to only introduce new antibiotics in triple-antibiotic mixes- thus, no microbe would be exposed to ampicillin that was not, at the same time, being exposed to tetracycline and ciprofloxacin. We know now that, while evolution of antibiotic resistance is often very easy (it is an exercise in my microbiology lab manual), evolving resistance to two or three at the same time is MUCH more difficult. Had we employed this strategy, I submit that the antibiotic resistance problem would be much different than it is today.

Dear Mr. and Mrs. Severinsen,

I am a faculty member in the biology and earth sciences department at UW-Superior. Although I did not know your daughter, I was saddened by news of her passing. I too have a daughter that is college age, and I can only begin to understand your grief. My prayer for you is that you will cling to Him who, more than any of us, knows sorrow, grief, and disappointment, and can strengthen you with His grace.

Wishing you Christ's grace and peace,

coded for by about 400,000 bases of DNA. This would put the challenge of assembling the first cell into its proper perspective.

A standard that is found is **Explain the importance of the fossil record:** this is one of the content statements. Yes, let's have students explain the importance of the fossil record. Let them understand that the overall trend is from simpler organisms to more complex ones. And let them understand that most of the body forms- flatworms and roundworms and fish and starfish and crabs and many others- all arose during a 5-20 million year period, the Cambrian Explosion. And that the fundamental characteristic of the fossil record is that organisms appear suddenly in the record, and remain unchanged for perhaps millions of years, and then become extinct.

**Explain how a new species or variety may originate through the evolutionary process of natural selection.** An excellent standard. It is also one that can be related to the "Practices of Science Literacy" standard related to scientific inquiry:

**"Use empirical evidence to validate or criticize conclusions about explanations and predictions"**

Let's have students learn about what natural selection has been shown capable of doing, and compare that to what it is required to do when forming a new body plan, such as evolution of amphibians from fish. It is an ideal place to emphasize the difference between interpolation and extrapolation. Let them decide for themselves whether natural selection is an adequate explanation for what is observed. There is certainly not uniformity in opinion on this subject among scientists!

#### **Two common criticisms of critical analysis of evolution**

Let me address two common criticisms for critical analysis of evolution. One is that high school students are simply unprepared to grasp the subtleties of the difficulties within evolutionary theory; it is thus best taught as unchallenged, with the difficulties left to the experts. To this I would respond that, if students can grasp the evidence that favors evolution (which is certainly there) they can also grasp the evidence that goes against the theory.

A more serious charge is that critical analysis of evolution is just a cloak for teaching Intelligent Design. This is simply not the case. The evidence for and against evolution can be plainly presented, without any reference to Design Theory. I would expect that the Michigan State Board of Education, in implementing this bill, will provide guidelines for teachers.

In closing, I urge your support for this bill. It is constitutional; it is solidly in the tradition of a liberal education; and it will produce a better informed citizenry, and more open-minded scientists.

END OF TESTIMONY